

**Oroville Facilities Relicensing Efforts
Environmental Work Group
Draft Narrative Reports for Resource Action Discussion**

Resource Action: EWG-89

Task Force Recommendation Category: 2

Proposed Spawning Habitat Enhancement by Creating Levee Setbacks

Date of Field Evaluation: June 11, 2003

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Description of Potential Resource Action: Create levee setbacks to increase meandering nature of river and improve gravel composition in critical spawning reaches of the low flow channel (LFC) of the Feather River. Improvement in gravel composition is to be achieved by allowing the stream to access and erode bank and floodplain deposits currently the boundaries of the levee system. This measure would also seek to increase the amount of fish spawning habitat by increasing the quantity of floodplain inundated by regulated flows.

There are several other Resource Actions that are either similar to or otherwise related to this measure:

- EWG-22, that would attempt to improve connectivity of the river with its floodplain in the lower Feather River by setting levees back.
- EWG-19A, that would modify or create “benches” or floodplain surfaces in the lower Feather River.
- EWG-16A and EWG-16B, which proposes enhancement of existing, or creation of new side channel habitat in the lower Feather River.
- EWG-92, that would improve spawning habitat in the low flow reach by direct placement of gravels.

Nexus to the Project:

The trapping of sediment behind the dam at Lake Oroville, coupled with the regulation of streamflow, have caused reductions in the quantity and quality of spawning habitat for anadromous fishes in the Feather River. The principle change has been an armoring of spawning habitat. The armored layer consists of substrate that is too large for redd construction in many places.

Levees and reduced peak flows have both reduced the accessibility of the Feather River to its floodplain. As a consequence, recruitment of sediment to the river through periodic floodplain and bank erosion has been substantially reduced.

Potential Environmental Benefits:

Most of the Feather River’s LFC is highly constrained by levees. As a result of this and other factors, natural fluvial geomorphic processes (channel migration, gravel recruitment, avulsions, etc.) have been altered, and that may have a negative impact on rearing habitat and spawning gravel quality. Geomorphically complex and active habitats are most closely associated with gradient changes and broad, unconfined

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active channel areas. Such habitats, particularly reaches with multiple channels, are typically the most productive rearing habitat for juvenile salmonids in large low gradient rivers like the lower Feather River.

The premise of this Resource Action is that setting levees back from their current positions would allow the river to erode its banks and floodplain. If the composition of the banks and floodplain consists of suitably sized gravels, and if the recruited material finds its way to spawning riffles, there could be improvements in salmonid spawning habitat quality and quantity. Creating levee setbacks would also provide connectivity with larger portions of the active channel and floodplains which are currently cut-off by levees. Increased floodplain area in turn, would increase the potential area of riparian vegetation. In addition, levee setbacks created in the LFC could improve wetlands, habitat for wildlife species, and enhance the aesthetic value of the river corridor.

Potential Constraints:

There are two potential constraints to this measure. First, setting back levees would likely require coordination with the U.S. Army Corps of Engineers (USACE) and possibly, local jurisdictions due to flood management concerns. Unless the levee setbacks are on public lands, private land acquisition would be required as well. Second, unless levee setbacks are coordinated with changes in flow management, it is unlikely that they will actually increase floodplain access or gravel recruitment. Under the current regulated flow regime in the LFC (flows maintained at 600 cubic feet per second (cfs)), enlarging the channel and/or floodplain would simply result in the dissipation of stream power and probably reduce erosion.

Existing Conditions in the Proposed Resource Action Implementation Area:

Habitat for anadromous salmonids in the LFC has been affected by the disruption of natural geomorphic processes due to myriad causes (hydraulic mining, land uses, levees), by the regulation of flow, and by the presence of the dam creating Lake Oroville. The dam blocks sediment recruitment from the upstream basin. Levees, and more specifically, bank armoring, prevent gravel recruitment from banks, abandoned channels, mine tailings, and floodplains.

Regulated flows are of sufficient magnitude to winnow gravels that do exist from spawning riffles resulting in armoring of the remaining substrate. Much of the stream bed substrate in the LFC is composed of larger gravels and cobbles too large for construction of spawning redds by salmon and steelhead. Despite these constraints, the LFC is by far the most important section of the river for salmon and steelhead spawning.

Most of the LFC is closely bounded by a complex system of levees, which include typically older levees, some of which are the responsibility of DWR. The effects of the levees are two-fold. Their principal impact is to disconnect the river from its floodplain, thereby preventing overbank flooding. A secondary impact is to prevent the stream from accessing alluvial deposits that could serve as sediment sources for gravel

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recruitment. Although specific information for the LFC is not yet available, most of the levees there are armored with cobbles (not artificial bank protection) that prevent erosion and lateral movement of the stream. Levees surrounding the Oroville Wildlife Area (OWA) have experienced at least two levee breaks due to past floods (at River Mile (RM) 61 and RM 63).

In addition to bank or levee erodibility, other factors that affect erosion are the volume and velocity of streamflow. Streamflow is highly regulated in the LFC. Consequently, there are rarely any floods of sufficient magnitude to initiate bank erosion. Only extreme floods (i.e., >100,000 cfs), such as those that occurred in 1965, 1986 and 1997 affect the LFC. During one of those events (either 1965 or 1986) the levee breaks at the OWA occurred. However, major widening of the channel did not occur, probably because of bank armoring.

Another effect of levees, particularly those that are well-protected against erosion, is to constrict flood flows thus increasing flood velocities and their potential to cause downstream erosion. Virtually the entire LFC is protected by closely set levees. That is not the case further downstream where the distance between levees is wider (between RM 39-54).

Because of water temperature constraints, the LFC is currently the only portion of the Feather River below Oroville dam suitable for year-around rearing of juvenile salmonids. Habitat with suitable depth, cover, and flow velocity conditions for rearing salmonids is, however, limited. Rearing habitat in the LFC is particularly important for steelhead, which generally rear for several months to a year or more before emigrating to sea. Most Feather River Chinook salmon begin their emigration within a month or two of emerging from redds.

In summary, the LFC is extremely important for salmonid spawning and rearing. However, both spawning and rearing habitat are limited. The main factors currently contributing to the limitations on habitat are the presence of the dam (preventing downstream sediment delivery), the regulated flow regime, and to some extent, the presence of levees that confine the channel and prevent development of habitat complexity.

Design Considerations and Evaluation:

The flow regime of the Feather River is the most important design consideration affecting the success of levee setbacks. The Oroville Project is currently operated to maintain relatively low, uniform flows through the LFC. High flows generally occur only during periods of extreme runoff. Creating levee setbacks under these flow conditions would have only limited value because the floodplain would only occasionally receive the high flows necessary to create productive habitat and recruit good quality spawning gravels. In addition, there is also a potential concern that setting back the levees may allow the channel to widen and not increase meandering. Furthermore, an increased

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surface area could potentially increase the water temperature of the lower Feather River.

Artificial side channel habitat and spawning habitat channels could be created in some floodplain areas (as discussed in the narrative report for EWG-16A), but such habitat could potentially have relatively high maintenance costs and may be less productive than side channel habitat naturally created by periodic floodwaters. Project operations (related to releases from Oroville Dam) could be altered to have the LFC, as well as the entire Feather River, more closely mimic a natural flow regime, with more frequent periods of high flows, including periodic flood events. Such a flow regime combined with levee setbacks would probably create rearing and spawning habitat for salmon and steelhead. Some contouring (or engineered structures) of floodplain land could be necessary prior to flooding to eliminate areas with potential for stranding redds and juveniles. Based on discussions with DWR personnel, two potentially suitable locations include: 1) the west side of the Feather River (River Mile (RM) 59 to RM 62 and RM 63 to RM 64); and 2) the east side of the Feather River (RM 50 to RM 59). The State reportedly owns the land for each of the above options.

In evaluating flow regimes that would be supportive of this measure, it would be necessary to develop stage-discharge relationships that could be used to evaluate post-levee removal floodplain inundation. The hydraulic modeling program, Fluvial 12 has been calibrated for use in the LFC and could be used to evaluate levee removal and flow management alternatives. Any flow management proposal needs to consider several factors including scheduling of flow to provide rearing habitat when it is most needed by juvenile salmonids. Another issue that would need to be addressed would be prevention of fish stranding. If flow in the LFC is greater than 2,500 cfs any time during October 15 through November 30, the 1983 agreement between the California Department of Fish & Game (DFG) and the California Division of Water Resources (DWR), requires the Oroville Project to provide that minimum flow (less 500 cfs) until the following March. This agreement is designed to minimize dewatering of redds and stranding juveniles in ponds or temporarily inundated channels.

Since the primary objective of this measure is to recruit spawning gravel, then another consideration would be whether or not the areas accessed by the stream due to levee set backs actually have gravel of appropriate sizes. The ability of different flows to move the gravels into the main channel and the likelihood that the gravel that is recruited would be retained there would also require evaluation. There is also some concern that deposits accessed by the stream might have some level of soil contaminants (e.g. from historic mining activities).

A number of undesirable plant species (exotics) inhabit the OWA and other former floodplain areas in the LFC corridor. Flooding of these areas could promote dispersal of the exotics to downstream areas currently free of these species. Mitigation against this would have to be incorporated into the measure.

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Creating levee setbacks would likely entail major earthmoving activities. Permits would probably be required from the DFG, State Water Quality Control Board and USACE. To minimize water quality problems associated with such activities, particularly turbidity and sedimentation, the work should be scheduled for summer, when the annual rainfall is lowest in the basin. A July through mid-August timeframe for earthmoving activities would probably present the least adverse effects on water quality on sensitive life stages of salmon and steelhead.

A measurement of success of this Resource Action would be newly created spawning and rearing habitats and their use by salmonids. Success would ultimately be measured by long-term salmon and steelhead escapement levels, although it might not be possible to determine the relative contribution a particular resource action enhancement measure to any increases in escapement.

Synergism and Conflicts:

Coordinating this measure with other measures aimed at replenishing spawning gravels (e.g., EWG-92) and improving the quality of spawning habitat (e.g., EWG-18/90) would be beneficial. It would also be advisable to coordinate planning for changes to the flow management regime with planning for this measure.

Unless there are changes to the flow regime to enhance the effectiveness of this measure, there could be conflicts with efforts to maintain suitable temperatures for salmonids in the LFC. Also, this measure could conflict with flood management objectives.

Uncertainties:

This measure would require complex engineering and environmental design analysis in relation to its main objective. There are several sources of uncertainty regarding this measure: 1) the suitability of potential locations for levee removal; 2) the required permitting and environmental documentation; 3) the key importance of the flow regime; 4) the potential for lands accessed by flows to produce the desired gravels; 5) the retention of recruited gravels at the appropriate places in the LFC (i.e., spawning riffles); and 6) the performance of the measure during extreme flooding events.

Cost Estimate:

Costs for this measure would depend on whether or not land acquisition would be required. Costs would also depend on the amount of levee removed and the amount that would be reconstructed. There is no information available to estimate these costs. However, simple levee breaching, without reconstruction would probably be an order of magnitude less in cost than levee relocation.

Recommendations:

Perhaps the principal issue with this measure is whether or not it is a good way to achieve spawning gravel enhancement. In levee set back projects proposed for other river systems (e.g., Sacramento, Cosumnes, Mokelumne, Truckee) the main objective

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has been to increase floodplain area and associated riparian habitat. This is probably a more workable objective for a levee set back project in the low flow reach of the Feather River.

Therefore, this Resource Action should be evaluated for effectiveness in comparison to or in combination with more direct measures for spawning gravel enhancement such as EWG-92. Also, as noted in the narrative report for EWG-94, there is a possibility to both enhance ponds in the OWA and produce gravel for direct placement. That Resource Action, which is incorporated into EWG-16A, EWG-16B, EWG-22, EWG-89, and/or EWG-92, would involve excavating ponds to increase their depth and water surface area. The excavated sediments could then be used for direct placement at spawning riffles.

Combining levee set backs with direct gravel placement would potentially have the effect of enhancing spawning riffle substrate suitability. The widened cross section and reduced stream power would increase the possibilities for gravel retention. This combined measure would not necessarily require major changes to flow management, although potential effects on stream temperature would have to be considered.